STATEMENT OF OBJECTIVES
FOR
Laser Induced Acoustic Sensor for Standoff Detection of Explosives
("Sherlock" and "Watson" Sensor)

May 2012

1.0 Scope

The proposed focus of this effort will be on the acousto-optical laser technology known as Laser Induced Acoustics (LIA). This follow-on effort will not involve Laser Induced Breakdown Spectroscopy (LIBS) or Laser Ablative Acoustics (LAA) that was combined with LIA in the previous work on the Multimode Laser-Based Sensor. The LIA technology detects invisible films and residues of explosive materials left on surfaces.

1.1 Background

This is an add-on project which builds upon the recently completed contract (#HDTRA1-09-C-0030) "Multimode Laser-Based Sensor for Standoff Detection of Explosives." There is a need for sensors that can counter the Improvised Explosive Device (IED) threat, the dominant method used by America's enemies to attack military installations and personnel as well as civilian targets. Current technologies available require close-in inspection of objects for explosive trace detection which can place friendly personnel in harm's way.

1.2 Objectives

The Contractor shall develop and test two prototype systems using orthogonal laser-based explosive sensing technology to detect explosive residue on the exteriors of suspected IED's, Vehicle Born IED's (VBIEDs), and other structures. Both sensors will utilize LIA technology. In addition to hardware development, advanced signal processing, and sensor fusion technologies will be developed to optimize the performance of the system. This effort will capitalize on the prior contract's results accumulated from the May 2011 Yuma Proving Ground tests conducted by DTRA and administered by the Naval Explosive Ordnance Disposal Technology Division (NAVEODTECHDIV). Two differentiate the two sensors, one will designed to be used on a tripod type mount for basic entry security applications, "Sherlock" Sensor, while the other system will be mounted on a robotic system, "Watson" Sensor.

2.0 Applicable Documents: DTRA Contract HDTRA1-09-C-0030

3.0 Requirements: The following Performance Requirement goals are established as criteria to assess the ability of the technology to achieve the desired performance.

3.1 Detect Common Explosives: The technology shall successfully determine, at the threshold level the presence of these explosive compounds: TNT, PETN, C4, HMX, ANFO, UN, NG, TATP, Perchlorates. At the objective level the

technology will detect all explosives previously listed in addition to EDGN, Smokeless Powder, and Black Powder. The technology should target detecting each explosive deposited on a collection site to a threshold level of 100 ng/cm2. The threshold for this task is detection of explosives with an objective of detection and identification of explosive by type.

3.2 Detection Effectiveness: The technology shall successfully determine the presence or absence of each of the detectible explosives and their corresponding mixtures, Semtex (RDX/PETN) and Comp B (RDX/TNT), in the laboratory or in the field with a threshold of 85% effective discrimination and an objective of 95% effective discrimination. The technology shall not falsely confirm the presence or absence of explosives more than 15% (threshold) with a goal of 5% (objective).

3.3 Surfaces: The technology's ability to determine the presence and absence of explosives should remain constant regardless of the surface being inspected. The surfaces should reflect at a minimum (threshold) those normally found on a motor vehicle: bare steel, painted steel, rusted steel, rubber (representative of tires and auto seals), glass, and painted fiberglass. At the goal (objective), the technology would also be able to detect on plastic, carpet, leather, and cloth. The system must be capable of detecting surfaces at the angles normally found on a motor vehicle.

3.4 Maintainability: The technology's ability to determine the presence or absence of explosives should remain constant and detection effectiveness of the prototype should not fluctuate more than 10% during testing.

3.5 Discrimination in the Presence of Confusants: The technology shall not falsely indicate the presence of explosives (false positives) under test conditions at a threshold level of more than 10% when common confusants are present. The confusants are substances that are commonly present within the operational environment at a point of entry or check point.

3.6 Masking Agents: The technology shall not falsely indicate the presence of explosives (false positives) under test conditions at a threshold level of more than 10% when masking agents are present. The masking agents are substances that are commonly present within the operational environment at a point of entry or check point.

3.7 Distance

3.7.1 Sherlock System:

Distance: Threshold 10 meters with an objective of 25 meters.

3.7.2 Watson System:

Distance: Threshold 5 meters with an objective of 10 meters.

3.8 Size of Sensor Element

3.8.1 Sherlock System:

Weight: Threshold 44 lbs. with an objective of 25 lbs.
Footprint: 12”X12”X36” threshold, 6”X6”X12” objective

3.8.2 Watson System:

Weight: Threshold 44 lbs. with an objective of 25 lbs.
Footprint: 12”X12”X36” threshold, 6”X6”X12” objective

3.9 Power: The sensor shall successfully operate using AC (110-240V) or DC power source. The start-up threshold is <15 minutes with an objective of <5 minutes. In the DC mode, the threshold run time is 1 hour.

4.0 Tasks: The contractor shall conduct a comprehensive program that is divided into the tasks listed below.

4. 1 Laser Upgrade: The Contractor shall refine the design of the LIA sensor. The laser upgrade should make the LIA sensor more tolerant to ambient temperature swings while reducing warm up times.

4. 2 Upgrade the Adaptable Detection Software: The Contractor shall upgrade the signal processing algorithms in the analysis portion of the software packages that run the sensor systems. The software upgrade will increase the reliability of the system on detecting explosive residues regardless of the patterns of deposition used.

4.3 Increase LIA Detection Range: The Contractor shall modify the optical system and microphones so that it has at a minimum a reliable standoff capability as outlined in paragraph 3.7.1 and 3.7.2. The goal is progress toward meeting the objective distances for both systems.

4.4 Decrease Surface Scanning Time: The Contractor shall refine the design of the scanning motors by adding an additional gearbox to increase the surface scanning time. The threshold is 3 minutes to scan a 12”X12” area, with an objective of 2 minutes

4.5 Integration of Co-Bore Sighted Video: The Contractor shall upgrade the video targeting system on the LIA sensor so that it is co-bore sighted with the laser.

4.6 Software Integration: The Contractor shall integrate the new software system into a single computer. Software improvements should work toward the objective of the software being able to identify the detected explosives.

4.7 DoD Laser Safety Agency Certification: The Contractor shall have the laser system certified by a DoD Agency to confirm power output as well as overall safety use.

4.8 Prototype Testing: Testing will be conducted in conjunction with the NAVEODTECHDIV or other specified agency at a government selected site.

4.9 Program Management: Perform all program management tasks.

4.10 Design and planning to achieve TRL 7 and beyond: Analyze and document improvements and enhancements needed to raise the technology readiness level (TRL) to 7 and beyond.

5.0 Deliverables: The Contract shall deliver a prototype of each LIA system (Sherlock + Watson =2) no later than 30 days after contract completion. The Contract Data Requirements Lists for this action include the following documentation:

5.1 Program Plan: The contractor shall provide, within 30 days after authority to proceed, a Program Plan to DTRA for review and approval. (CDRL A001)

5.2 Progress Reports: The contractor shall provide Monthly Progress Reports in a government approved format. The reports shall detail work plans, technical status, progress made, technical milestones, meetings and travel, and updated risk assessment. The report shall also contain cost and schedule status and include copies of government invoices. (CDRL A002)

5.3 Program Reviews: The contractor shall provide formal Quarterly Program Reviews (QPRs) at an agreed upon location, either at DTRA, the contractor's facility, or via teleconference. The contractor will prepare briefing slides that cover at a minimum the pertinent data from that quarter's monthly reports. The contractor will also prepare meeting minutes of the QPR. (CRDL A003)

5.4 Special Reports: The contractor shall provide Status of Government Furnished Equipment Report and Master Government Property – Physical Inventory Reports semi-annually. Scientific and Technical Reports will be provided by the contractor as required. (CDRL A004)

5.5 Final Project Reports: The contractor will provide a Final Project report at the completion of contract. Additionally, a technical data package and a preliminary Operations and Maintenance manual for the LIA sensors will be provided when the prototypes are delivered. (CDRL A005)

6.0 Other Requirements

6.1 Travel: Travel to program meetings at DTRA, test activities, subcontractor facilities, and technical meetings.

6.2 Security:

A Contract Security Classification Specification (DD-254) shall be provided to support the program.